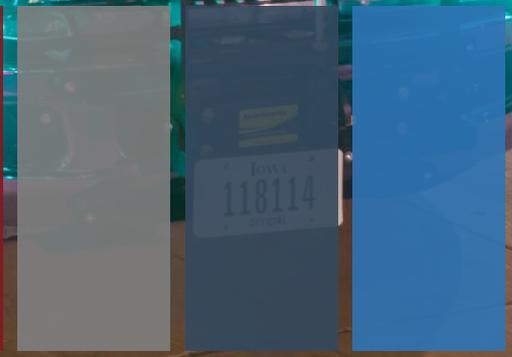




Transit Dependency Analysis
MPO/RPA Joint Quarterly Meeting
June 24, 2020

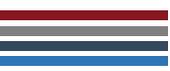




Agenda

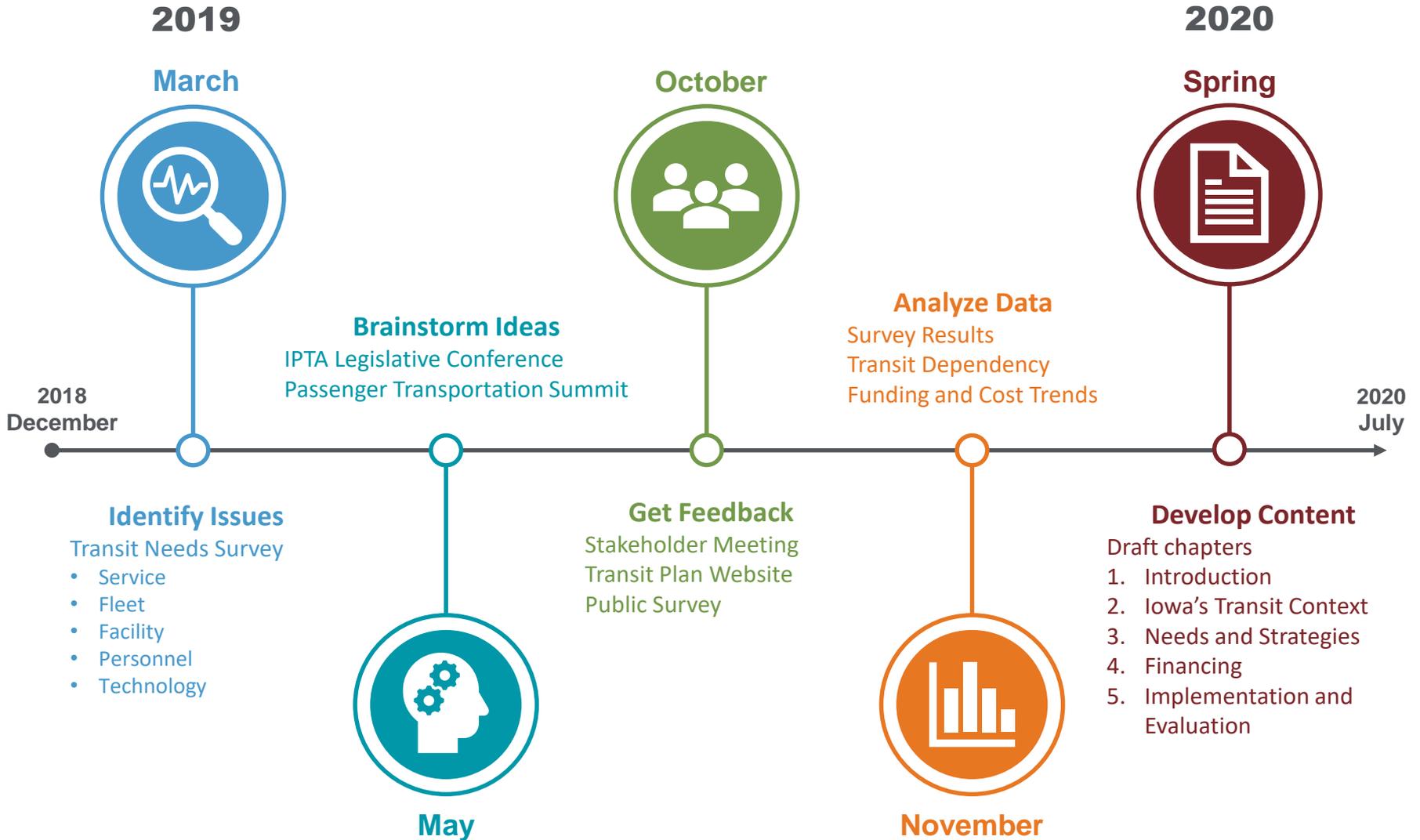
Transit Dependency Analysis

- ▶ Roadmap
- ▶ Background
- ▶ Methodology
- ▶ Results
- ▶ Example Application
- ▶ Next Steps



Roadmap

Transit Dependency Analysis

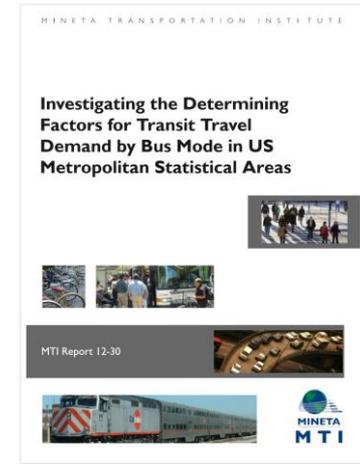


Goals

- ▶ Measure transit ‘need’
- ▶ Where are there gaps in the system?

Mineta Transportation Institute

- ▶ “Investigating the Determining Factors for Transit Travel Demand by Bus Mode in US Metropolitan Statistical Areas”
 - ▶ San José State University
 - ▶ May 2015
- ▶ Attempt to determine general conclusions to provide policy recommendations regarding public transit.
- ▶ Go beyond specific studies on the uniqueness of a single or a few transit systems.



San José State University (SJSU):
<https://transweb.sjsu.edu/research/investigating-determining-factors-transit-travel-demand-bus-mode-us-metropolitan>

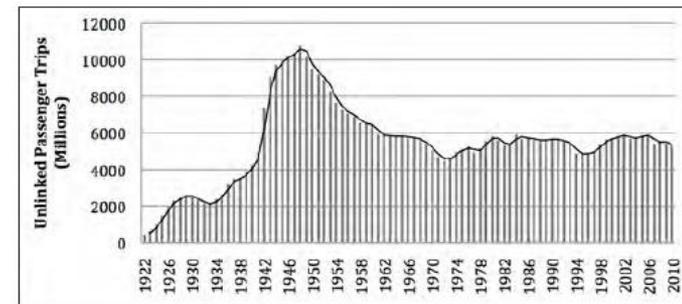


Figure 1. Annual Transit Ridership Trend by Bus, 1922 to 2010

Data Source: American Public Transportation Association 2012. Public Transportation Fact Book, Appendix A: Historical Tables.

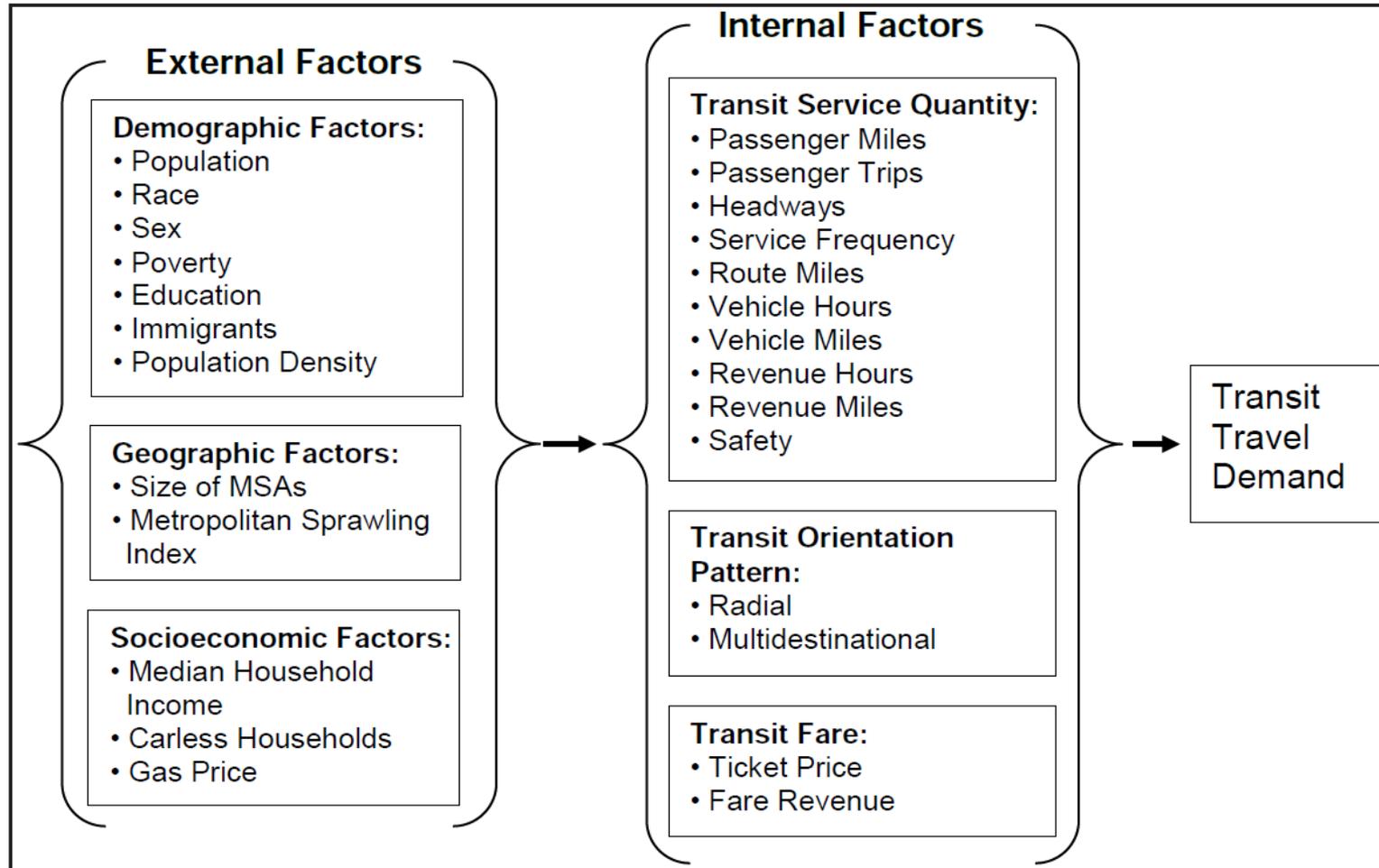


Figure 2. Conceptual Diagram of Transit Demand Analysis

Source: Adapted from Taylor et al. (2009) and Thompson and Brown (2006).

What Factors to Use?

Table 4. Explanatory Variables' Expected and Demonstrated Impacts on Transit Travel Demand by Bus Mode

Explanatory Variable	Expected Behavior	Demonstrated Behavior	
		Sign	Significant?
[Removed]			
Rail Transit	Negative	Negative	No
Gas Price	Positive	▶ Too limited in Iowa. Mostly a single line that runs east-west in southern Iowa.	No
Metropolitan Sprawling Index	Positive		No
Median Household Income	Negative		No
Percent of African American Population	Positive	Vehicles per Household	No
Percent of Carless Households	Positive	▶ Similar to Percent of Carless Households	No
Vehicles per Household	Negative	Metro Sprawling Index, MSAs in the South	No
Percent of College Population	Positive	▶ Wanted to look at urban and rural areas	No
Percent of Immigrant Population	Positive	▶ Sprawl not relevant	No
MSAs in the South	Positive	▶ MSA boundaries not relevant	No
Population Density	Positive	▶ Midwest, not the South	No
[Changed]			
Transit Orientation Pattern	Positive		No
Transit Fare	Negative		Yes
Transit Supply	Positive	Percent of African American Population	Yes
Revenue Hours	Positive	▶ Broadened to be all non-white population	Yes
Average Headway	Negative		Yes
Safety	Negative	Percent of Immigrant Population	Yes
Transit Coverage	Positive	▶ Initially used foreign-born, then settled on non-English speaking	Yes
Service Intensity	Negative		Yes

Input

- ▶ U.S. Census Bureau, American Community Survey 5-year estimates
- ▶ AAA Gas Prices (except O'Brien County)
- ▶ Gas Buddy (only O'Brien County)



American FactFinder (AFF) will be taken offline on March 31, 2020. Most data previously released on AFF are now being released on the U.S. Census Bureau's new dissemination platform, data.census.gov. For more information about the transition from American FactFinder to data.census.gov, see Transition from AFF. Included on this page are information on historic AFF data, documentation on updating AFF links, and resource materials, including tutorials, webinars, and how-tos on using data.census.gov. If you have questions or comments, please email: cedo3.feedback@census.gov.

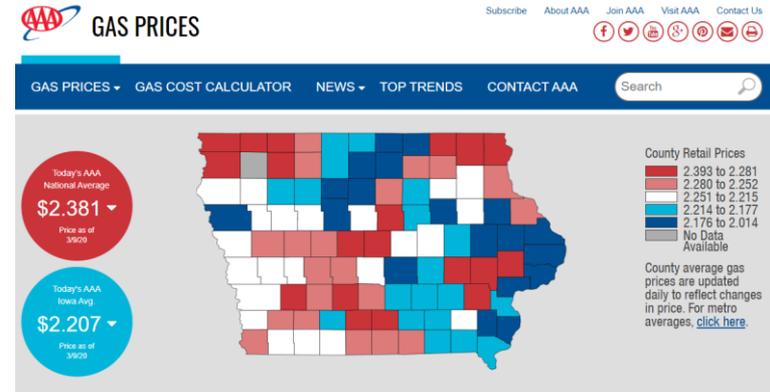
Search - Use the options on the left (topics, geographies, ...) to narrow your search results

Your Selections: Search using... People Income & Earnings Income/Earnings (Household) 10 Black Group within Census Tract 10 selected

Search Results: 720 of 496 tables and other products match "Your Selections"

ID	Table, File or Document Title	Dataset	About
B19001	HOUSEHOLD INCOME IN THE PAST 12 MONTHS (IN 2017 INFLATION-ADJUSTED DOLLARS)	2017 ACS 5-year estimates	1
B00510	RATIO OF INCOME TO POVERTY LEVEL IN THE PAST 12 MONTHS BY NATIVITY OF CHILDREN UNDER 18 YEARS IN FAMILIES AND SUBFAMILIES BY LIVING ARRANGEMENTS AND NATIVITY OF PARENTS	2017 ACS 5-year estimates	1
B09010	RECEIPT OF SUPPLEMENTAL SECURITY INCOME (SSI), CASH PUBLIC ASSISTANCE INCOME, OR FOOD STAMPS/SHIP IN THE PAST 12 MONTHS BY HOUSEHOLD TYPE FOR CHILDREN UNDER 18 YEARS IN HOUSEHOLDS	2017 ACS 5-year estimates	1
B19010	MEDIAN FAMILY INCOME FOR FAMILIES WITH GRANDPARENT HOUSEHOLDERS AND/OR SPOUSES LIVING WITH OWN GRANDCHILDREN UNDER 18 YEARS BY RESPONSIBILITY FOR OWN GRANDCHILDREN AND PRESENCE OF GRANDCHILDREN	2017 ACS 5-year estimates	1
B17011	AGGREGATE INCOME DEFICIT (DOLLARS) IN THE PAST 12 MONTHS FOR FAMILIES BY FAMILY TYPE	2017 ACS 5-year estimates	1
B17015	POVERTY STATUS IN THE PAST 12 MONTHS OF FAMILIES BY FAMILY TYPE BY SOCIAL SECURITY INCOME BY SUPPLEMENTAL SECURITY INCOME (SSI) AND CASH PUBLIC ASSISTANCE INCOME	2017 ACS 5-year estimates	1
B17022	RATIO OF INCOME TO POVERTY LEVEL IN THE PAST 12 MONTHS OF FAMILIES BY FAMILY TYPE BY PRESENCE OF RELATED CHILDREN UNDER 18 YEARS BY AGE OF RELATED CHILDREN	2017 ACS 5-year estimates	1
B17026	RATIO OF INCOME TO POVERTY LEVEL OF FAMILIES IN THE PAST 12 MONTHS	2017 ACS 5-year estimates	1
B19001A	HOUSEHOLD INCOME IN THE PAST 12 MONTHS (IN 2017 INFLATION-ADJUSTED DOLLARS) (WHITE ALONE HOUSEHOLDER)	2017 ACS 5-year estimates	1
B19001B	HOUSEHOLD INCOME IN THE PAST 12 MONTHS (IN 2017 INFLATION-ADJUSTED DOLLARS) (BLACK OR AFRICAN AMERICAN ALONE HOUSEHOLDER)	2017 ACS 5-year estimates	1
B19001C	HOUSEHOLD INCOME IN THE PAST 12 MONTHS (IN 2017 INFLATION-ADJUSTED DOLLARS) (AMERICAN INDIAN AND ALASKA NATIVE ALONE HOUSEHOLDER)	2017 ACS 5-year estimates	1
B19001D	HOUSEHOLD INCOME IN THE PAST 12 MONTHS (IN 2017 INFLATION-ADJUSTED DOLLARS) (ASIAN ALONE HOUSEHOLDER)	2017 ACS 5-year estimates	1
B19001E	HOUSEHOLD INCOME IN THE PAST 12 MONTHS (IN 2017 INFLATION-ADJUSTED DOLLARS) (NATIVE HAWAIIAN AND OTHER PACIFIC ISLANDER ALONE HOUSEHOLDER)	2017 ACS 5-year estimates	1
B19001F	HOUSEHOLD INCOME IN THE PAST 12 MONTHS (IN 2017 INFLATION-ADJUSTED DOLLARS) (SOME OTHER RACE ALONE HOUSEHOLDER)	2017 ACS 5-year estimates	1
B19001G	HOUSEHOLD INCOME IN THE PAST 12 MONTHS (IN 2017 INFLATION-ADJUSTED DOLLARS) (TWO OR MORE RACES HOUSEHOLDER)	2017 ACS 5-year estimates	1
B19001H	HOUSEHOLD INCOME IN THE PAST 12 MONTHS (IN 2017 INFLATION-ADJUSTED DOLLARS) (WHITE ALONE, NOT HISPANIC OR LATINO HOUSEHOLDER)	2017 ACS 5-year estimates	1

Source: <https://factfinder.census.gov/>



Source: <https://gasprices.aaa.com/?state=IA>



Factor	Size	Description
Gas Prices	County	Average gas prices from AAA web site with samples taken between June and November 2019.
Median Household Income	Block Group	Average household income for the block group.
Carless Households	Block Group	Percentage of all households with zero vehicles available.
Language	Block Group	Percentage of households where English is spoken “not well” or “not at all”
Race	Block Group	Percentage of households classified as not “White”
College Enrolled	Block Group	Percentage of households that are enrolled in “college, undergraduate, graduate or professional school”
Population Density	Block Group	Density of population per square kilometer (land area only – water area not included).

Data_Analysis.mxd - ArcMap

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

1:2,421,775

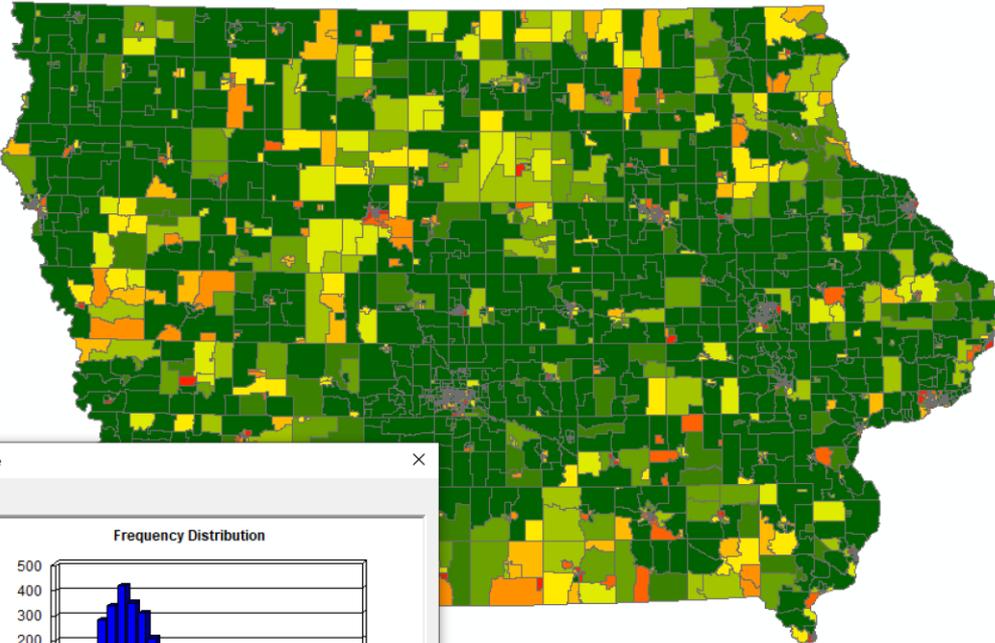
Editor

Snapping

Spatial Adjustment

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- Transit Ridership Dependency Analysis
 - \\ntdfs\(\W)\DataStor\Planning\SystemPlanning\Tr...
 - BG_boundary
 - Median Household Income (Normalized)
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 - 10
 - BG_CarlessHousingUnits_table
 - BG_CollegeEnrolled_table
 - BG_ForeignBorn_table
 - BG_Language_table
 - BG_MedianHouseholdIncome_table
 - BG_PopulationDensity_table
 - BG_Race_table
 - CO_GasPrices_table



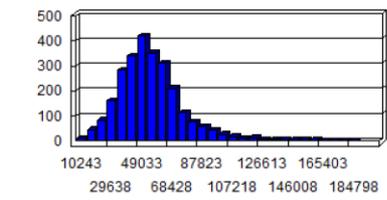
Statistics of BG_MedianHouseholdIncome_table

Field: Estimate: Median household income in th

Statistics:

- Count: 2587
- Minimum: 10243
- Maximum: 185486
- Sum: 147812000
- Mean: 57136.451488
- Standard Deviation: 20140.88238
- Nulls: 43

Frequency Distribution



10243 49033 87823 126613 165403
29638 68428 107218 146008 184798

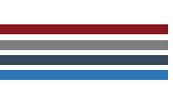
Id2*	Geography	Estimate: Median household income in the past 12 months (in 2017 inflation-adjusted dollars)	Median Household Income (Normalized)
190019601001	Block Group 1, Census Tract 9601, Adair County, Iowa	55461	9
190019601002	Block Group 2, Census Tract 9601, Adair County, Iowa	52396	8
190019601003	Block Group 3, Census Tract 9601, Adair County, Iowa	43958	5
190019602001	Block Group 1, Census Tract 9602, Adair County, Iowa	72667	10
190019602002	Block Group 2, Census Tract 9602, Adair County, Iowa	53077	8
190019603001	Block Group 1, Census Tract 9603, Adair County, Iowa	32216	2
190019603002	Block Group 2, Census Tract 9603, Adair County, Iowa	59615	10
190019603003	Block Group 3, Census Tract 9603, Adair County, Iowa	33611	2

Table: BG_MedianHouseholdIncome_table

(0 out of 2630 Selected)

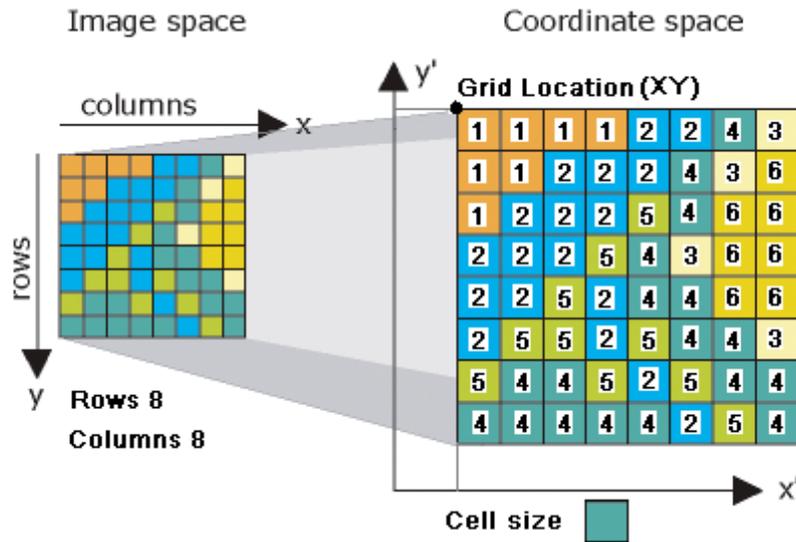
BG_MedianHouseholdIncome_table

-90.066 40.21 Decimal Degrees



Methodology

Iowa Public Transit Long Range Plan



ArcGIS Desktop - ArcGIS Pro - ArcMap

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ArcMap

Home | Get Started | Map | Analyze | Manage Data | Tools | Extensions

Tools > Tool reference > Conversion toolbox > To Raster toolset > To Raster-toolset concepts

An overview of the To Raster toolset

- ASCII to Raster
- DEM to Raster
- Feature to Raster
- Float to Raster
- LAS Dataset to Raster
- Multipatch to Raster
- Point to Raster
- Polygon to Raster
- Polyline to Raster
- Raster To Other Format
- To Raster toolset concepts**
 - How DEM to Raster works
 - Converting features to raster data**
 - Boundary rules followed when converting features to a raster
 - How Point to Raster works
 - How Polygon to Raster works
 - How Polyline to Raster works

Converting features to raster data

ArcMap 10.8 | Other versions *

- ▣ Polygon features to raster data
- ▣ Polyline features to raster data
- ▣ Point features to raster data

You can convert any feature class (polygon, polyline, or point) to a raster with the Feature To Raster tool. For more control over how the features are converted you can use any of these:

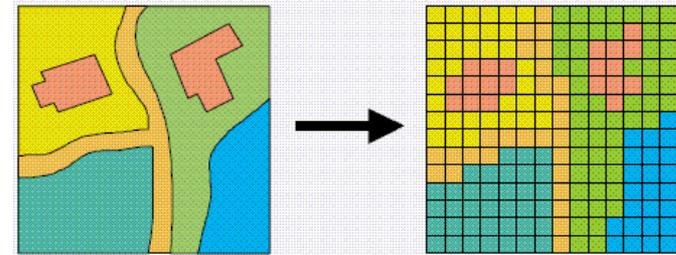
- ▣ Polygon to Raster tool
- ▣ Polyline to Raster tool
- ▣ Point to Raster tool

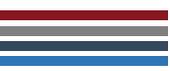
Polygon features to raster data

When you convert polygons, cells are usually given the value of the polygon found at the center of each cell.

The first image shows polygon features as the input; the second image shows the output raster dataset. These images have been simplified to help show the differences.

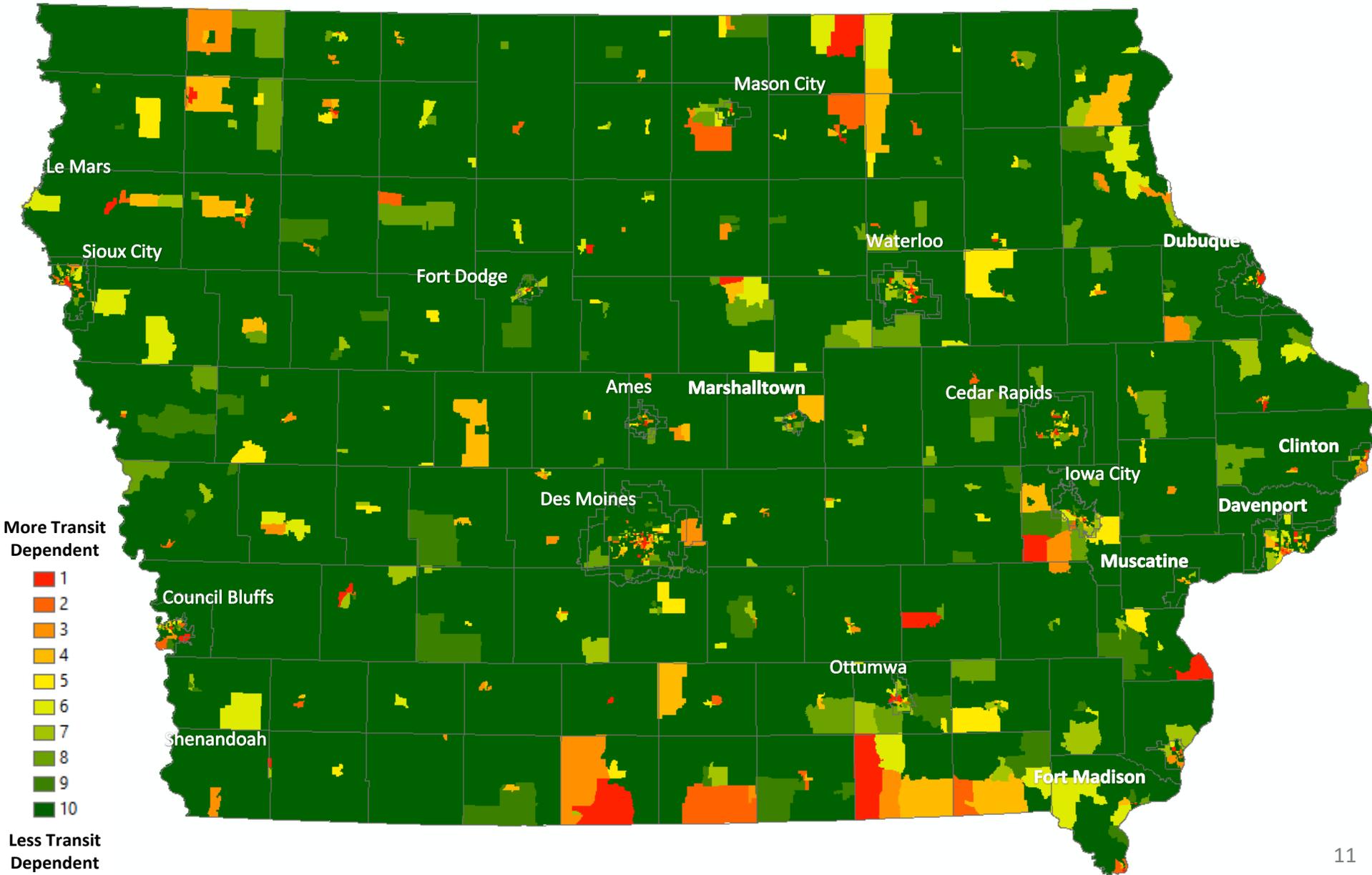
Input polygons Output raster

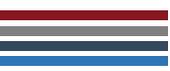




Results – Carless Households

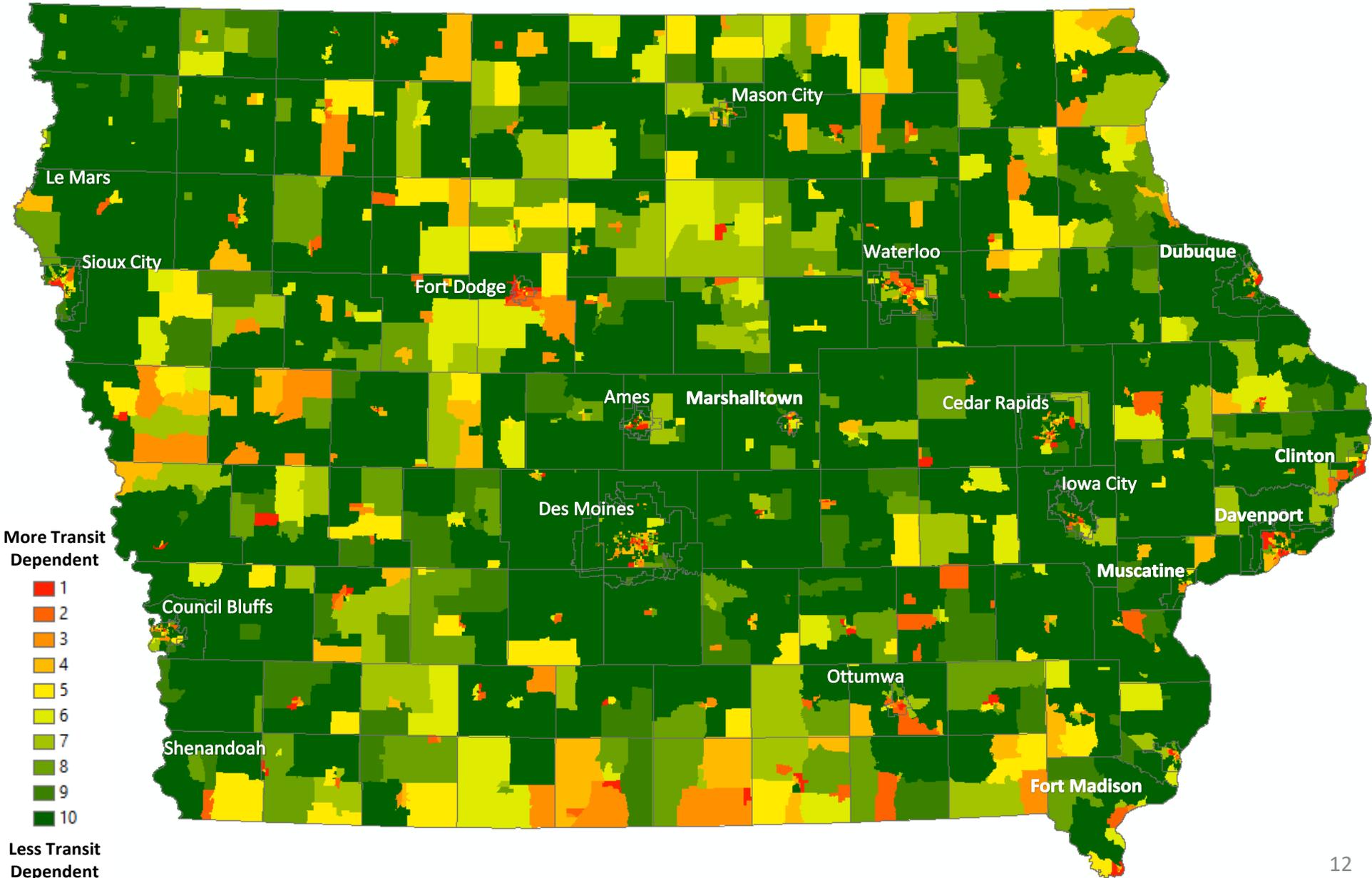
Transit Dependency Analysis

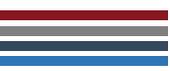




Results – Median Household Income

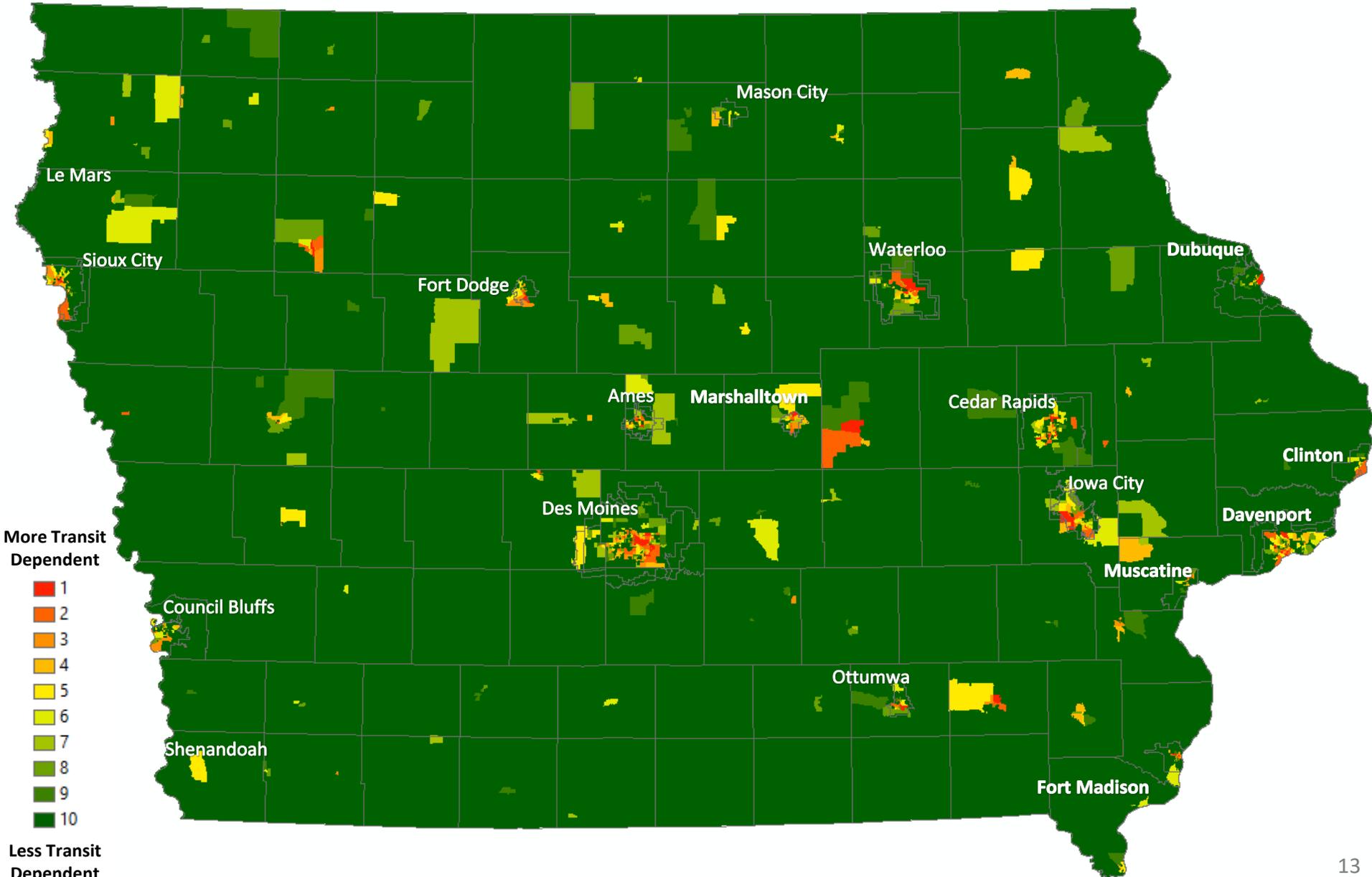
Transit Dependency Analysis

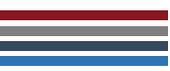




Results – Race

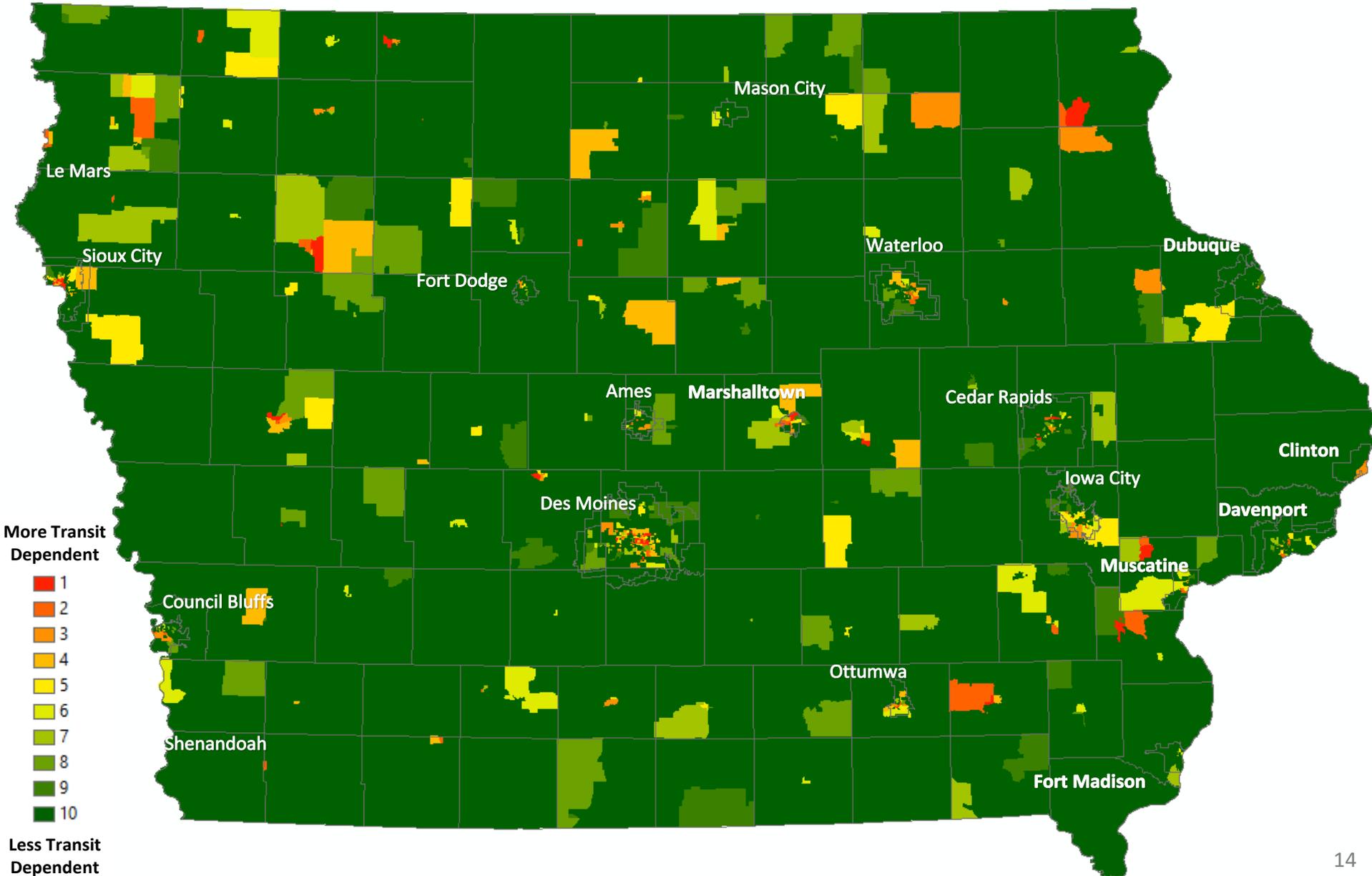
Transit Dependency Analysis

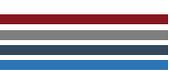




Results – Language

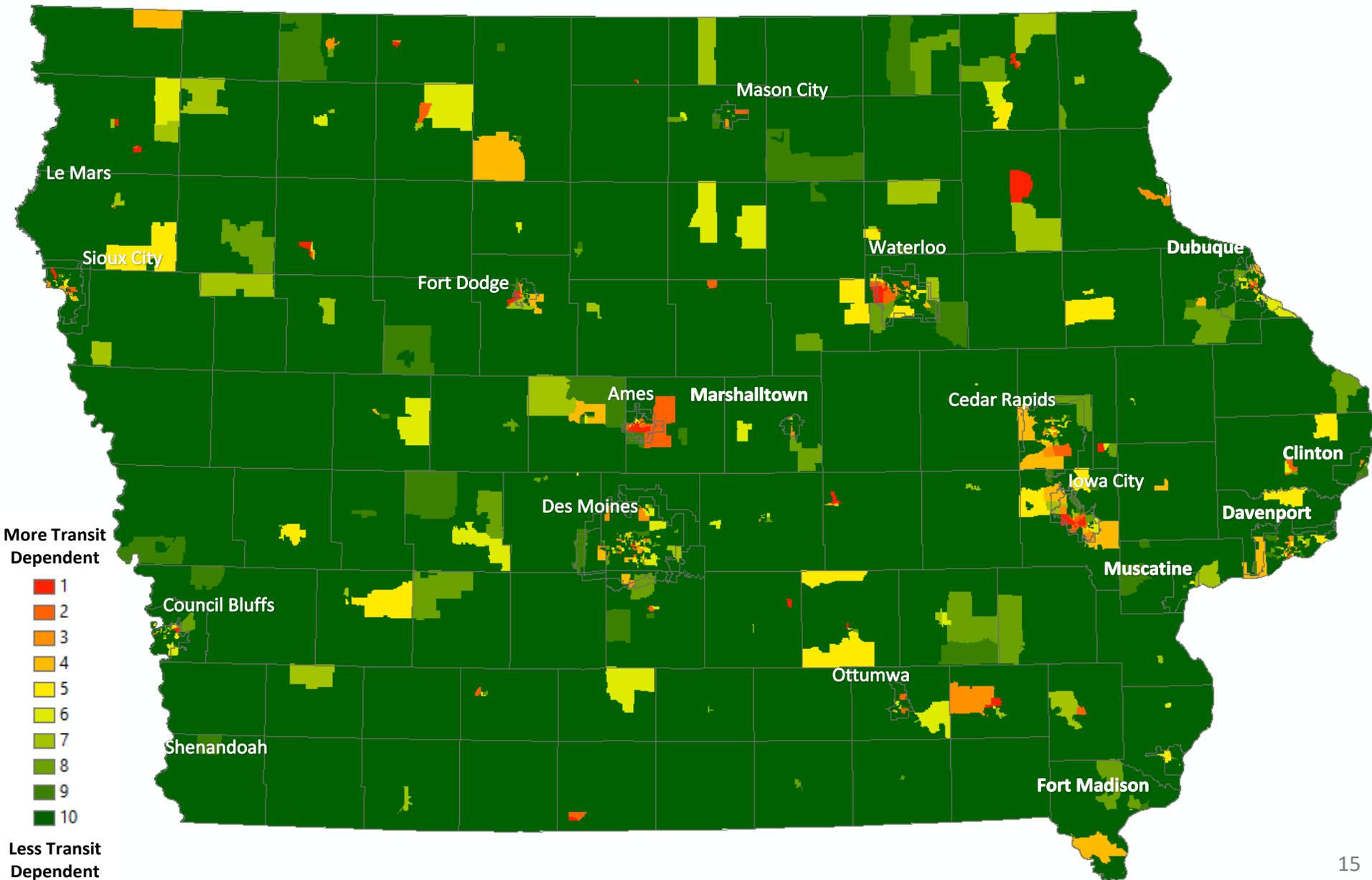
Transit Dependency Analysis





Results – College Enrolled

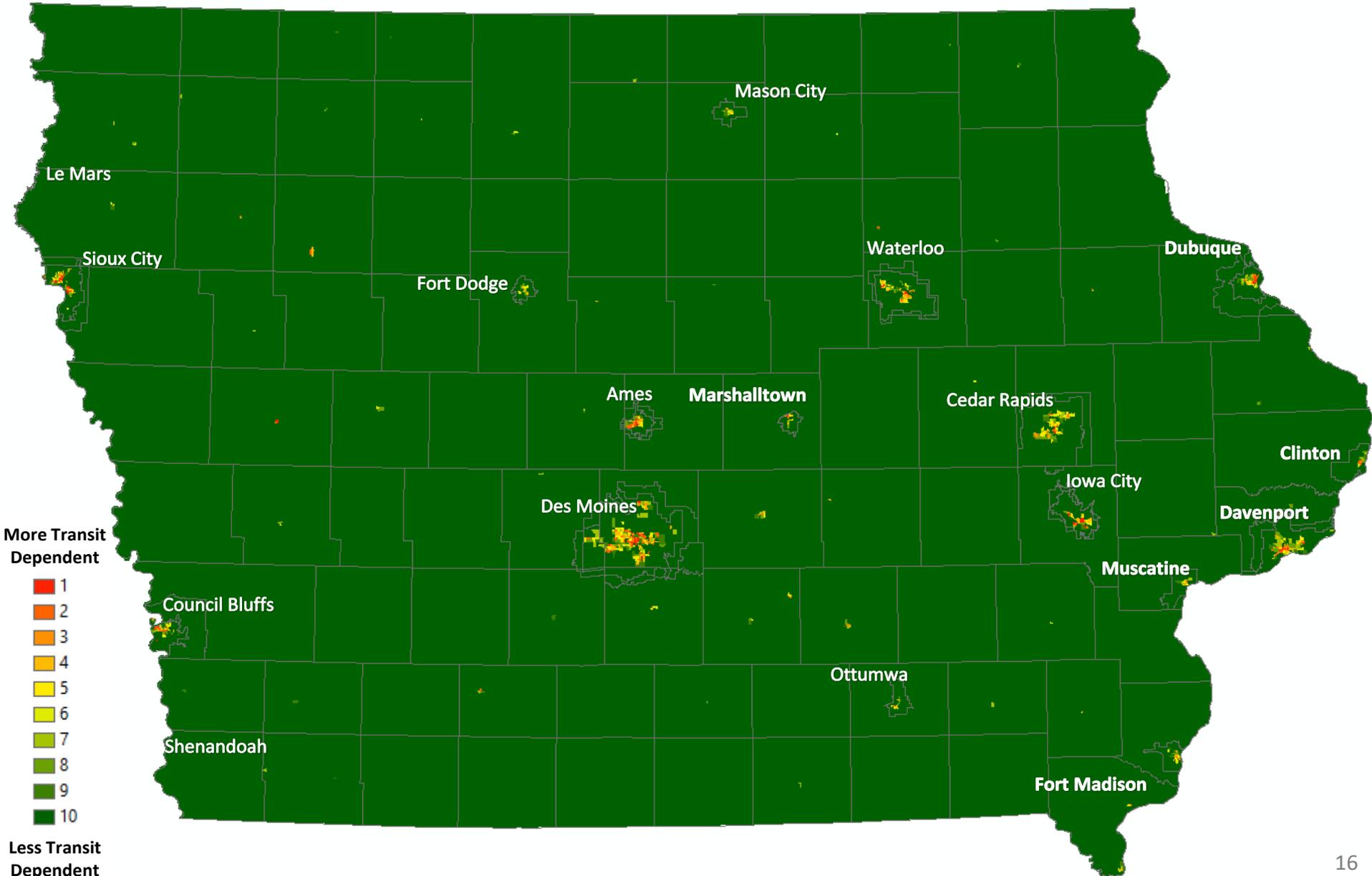
Transit Dependency Analysis





Results – Population Density

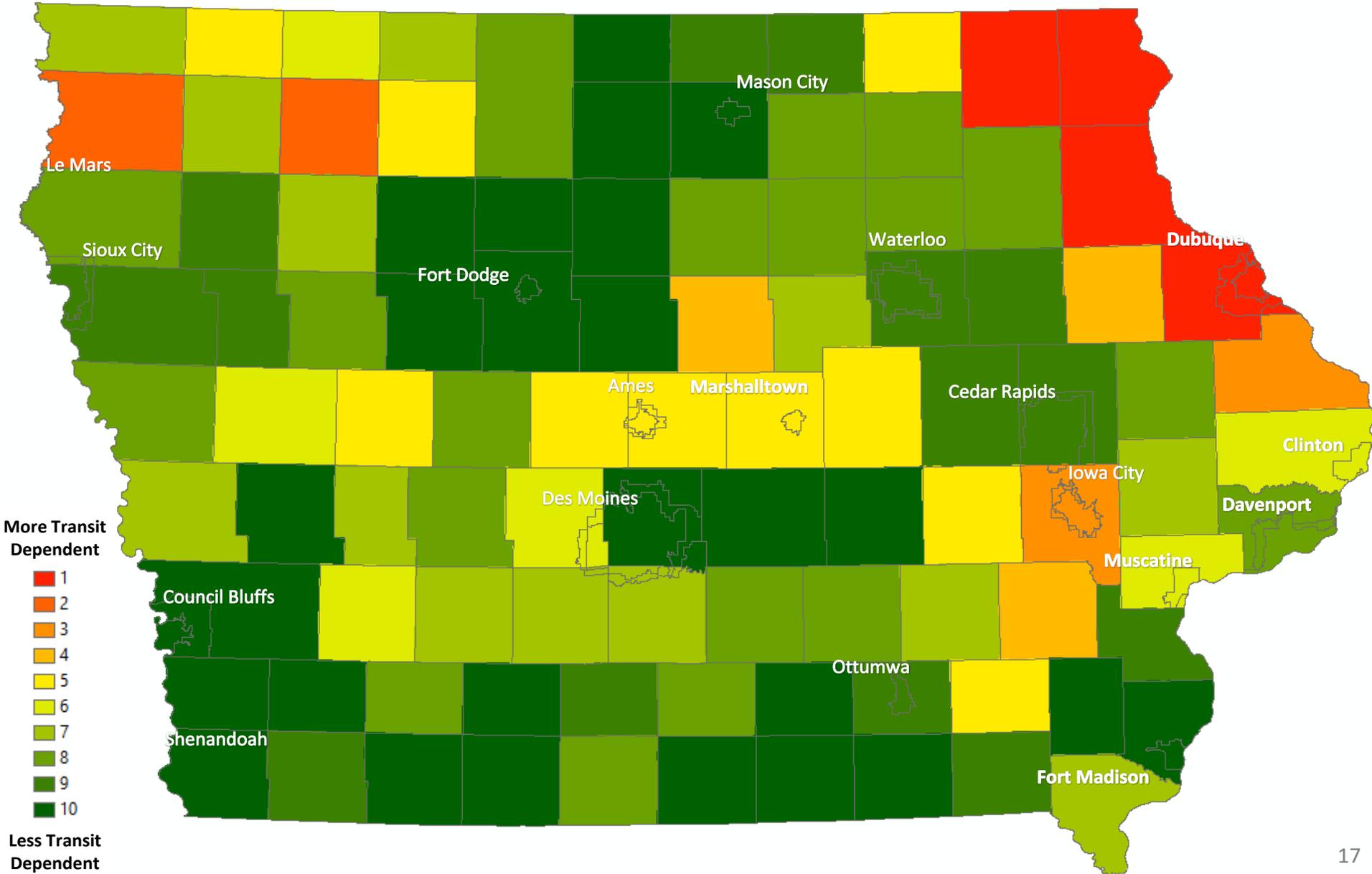
Transit Dependency Analysis

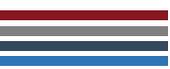




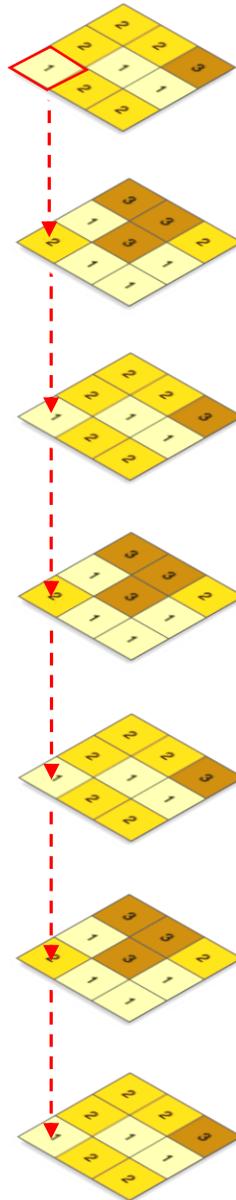
Results – Gas Prices

Transit Dependency Analysis





- Gas Prices**
- Median Household Income**
- Carless Households**
- Language**
- Race**
- College Enrolled**
- Population Density**



ArcGIS Desktop - ArcGIS Pro - ArcMap

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ArcMap

Home Get Started Map Analyze Manage Data Tools Extensions

Tools > Tool reference > Spatial Analyst toolbox > Overlay toolset > Overlay toolset concepts

An overview of the Overlay toolset

- Fuzzy Membership
- Fuzzy Overlay
- Locate Regions
- Weighted Overlay
- Weighted Sum
- Overlay toolset concepts
 - Understanding overlay analysis
 - Overlay analysis approaches
 - How Weighted Overlay works**
 - How Weighted Sum works
 - Applying fuzzy logic to overlay rasters
 - How Fuzzy Membership works
 - How Fuzzy Overlay works
 - How the Locate Regions tool works

How Weighted Overlay works

ArcMap 10.7 | Other versions -

▲ Available with Spatial Analyst license.

- Using the Weighted Overlay tool
- Running the Weighted Overlay tool
- Using Restricted and NoData for the scale value
- Weighted Overlay tool example

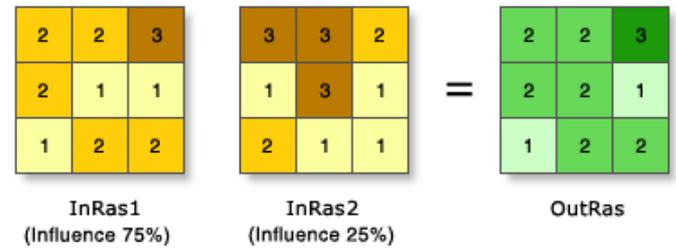
The Weighted Overlay tool applies one of the most used approaches for overlay analysis to solve multicriteria problems such as site selection and suitability models. In a weighted overlay analysis, each of the general overlay analysis steps is followed.

Learn more about overlay analysis

As with all overlay analysis, in weighted overlay analysis, you must define the problem, break the model into submodels, and identify the input layers.

Since the input criteria layers will be in different numbering systems with different ranges, to combine them in a single analysis, each cell for each criterion must be reclassified into a common preference scale such as 1 to 10, with 10 being the most favorable. An assigned preference on the common scale implies the phenomenon's preference for the criterion. The preference values are on a relative scale. That is, a preference value of 10 is twice as preferred as a preference value of 5.

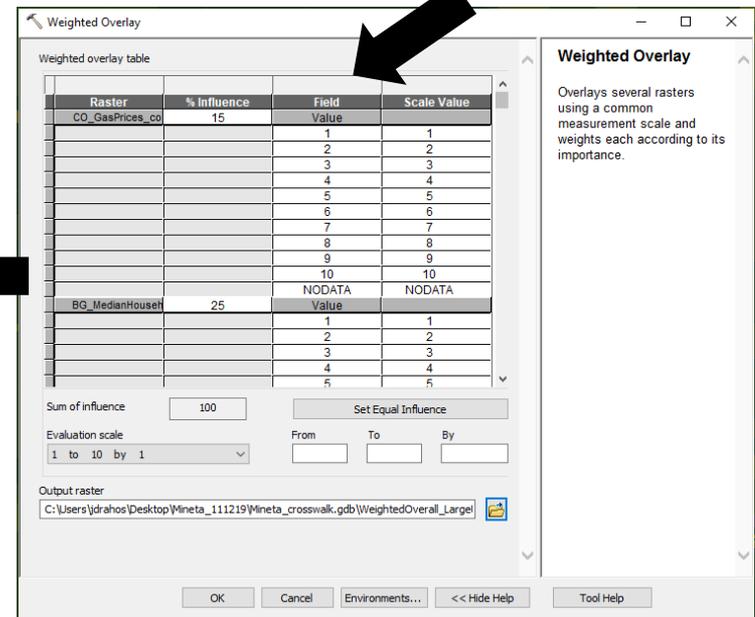
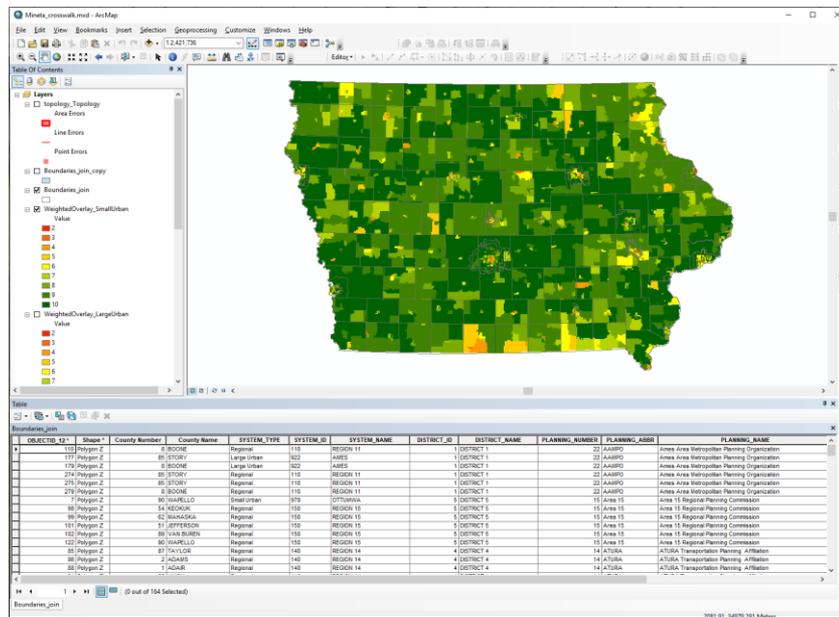
The preference values should not only be assigned relative to each other within the layer but also have the same meaning between the layers. For example, if a location for one criterion is assigned a preference of 5, it will have the same influence on the phenomenon as a 5 in a second criterion.

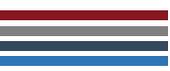


Transit Agency Feedback

- Consolidated analysis weighting feedback from Transit Agencies. 15 total responses; same ratio of large : small : regional.

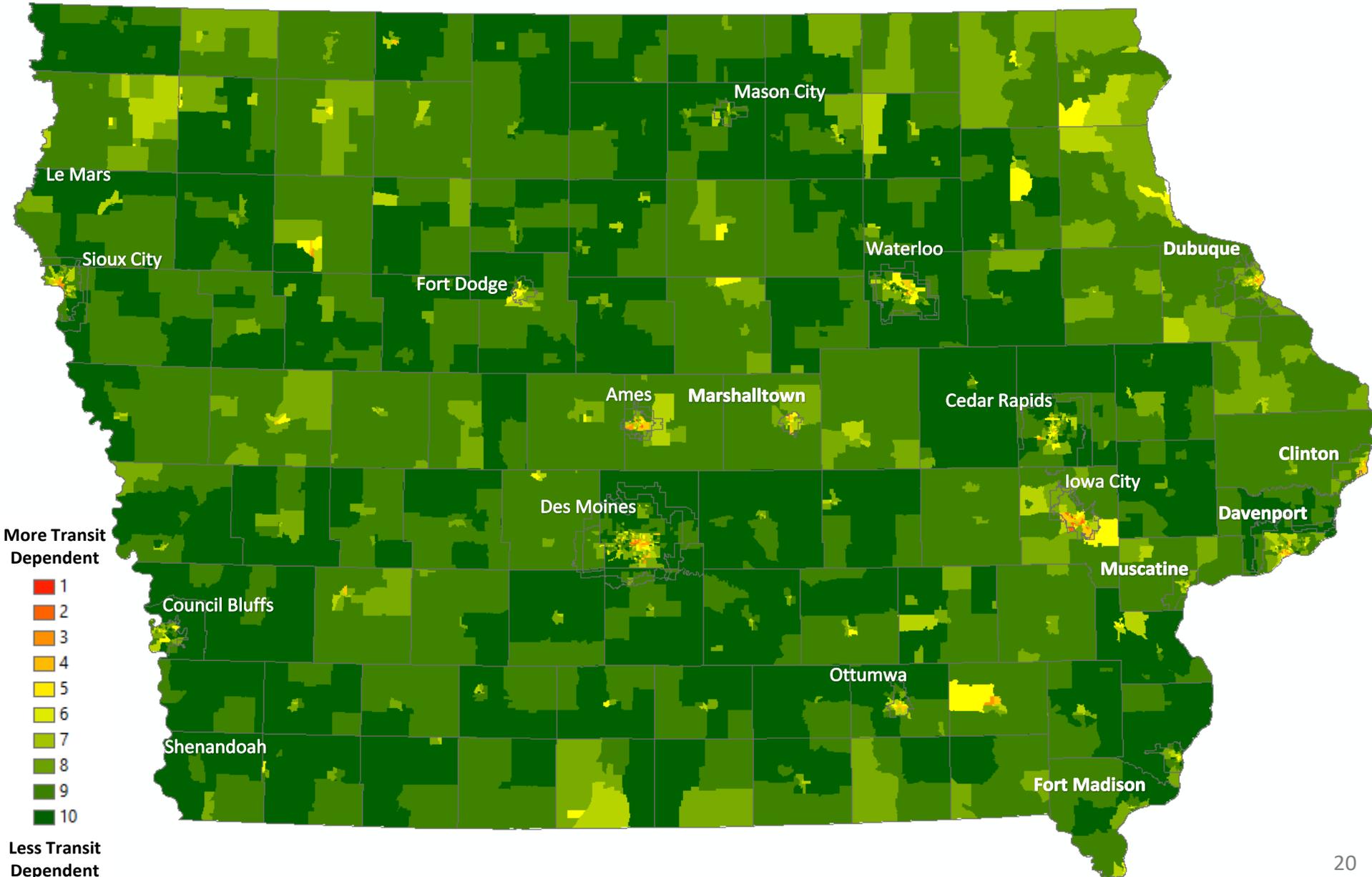
Factor	Final			
	Large Urban	Small Urban	Regional	All
<u>1. Gas Prices</u>	15	10	20	20
<u>2. Household Income</u>	25	30	20	20
<u>3. Carless Households</u>	25	40	30	30
<u>4. Language</u>	5	5	5	5
<u>5. Race</u>	5	5	5	5
<u>6. Enrolled in College</u>	10	5	5	5
<u>7. Population Density</u>	15	5	15	15

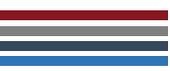




Results – Non-Weighted

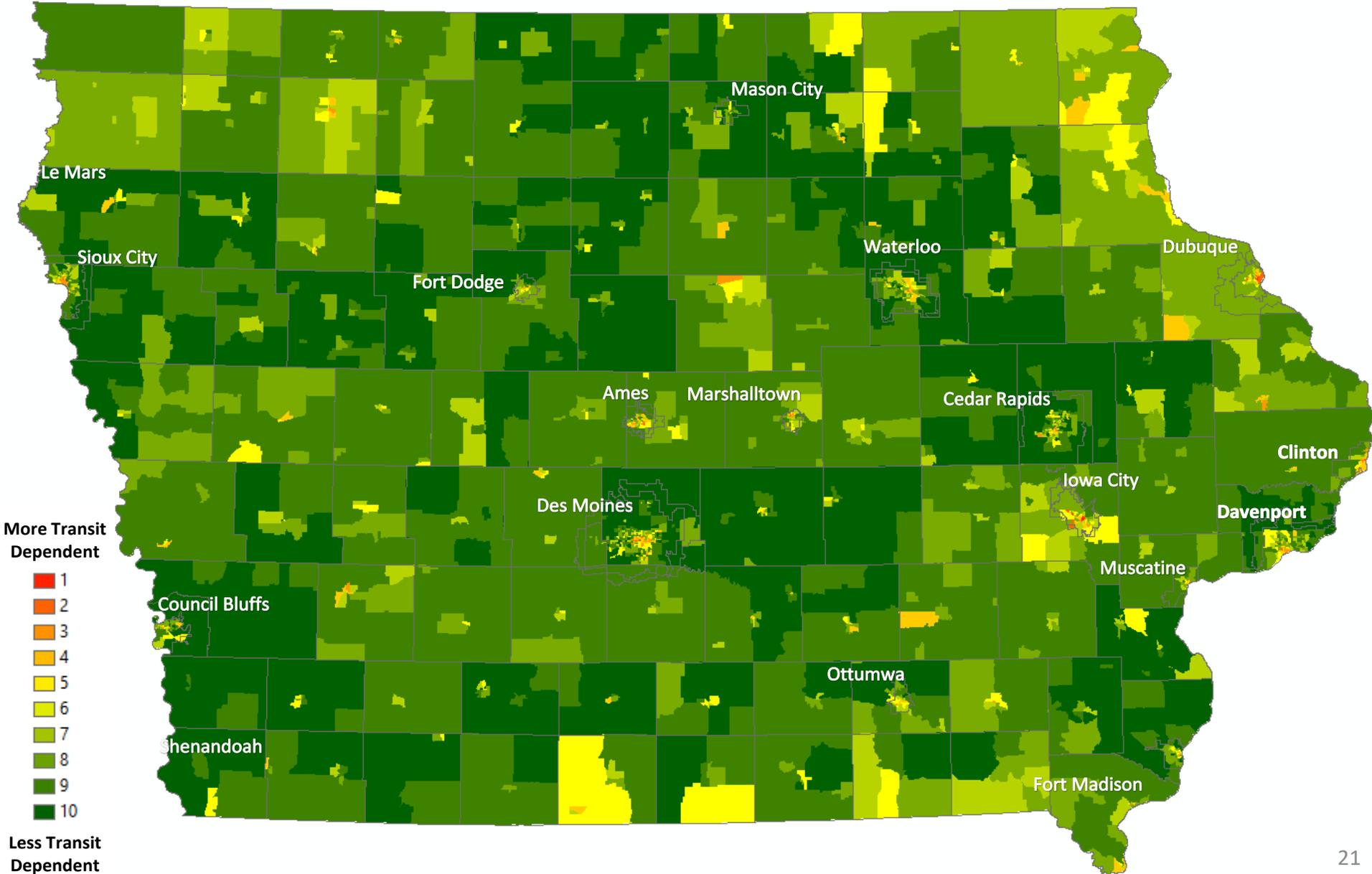
Transit Dependency Analysis





Results – Overall Composite

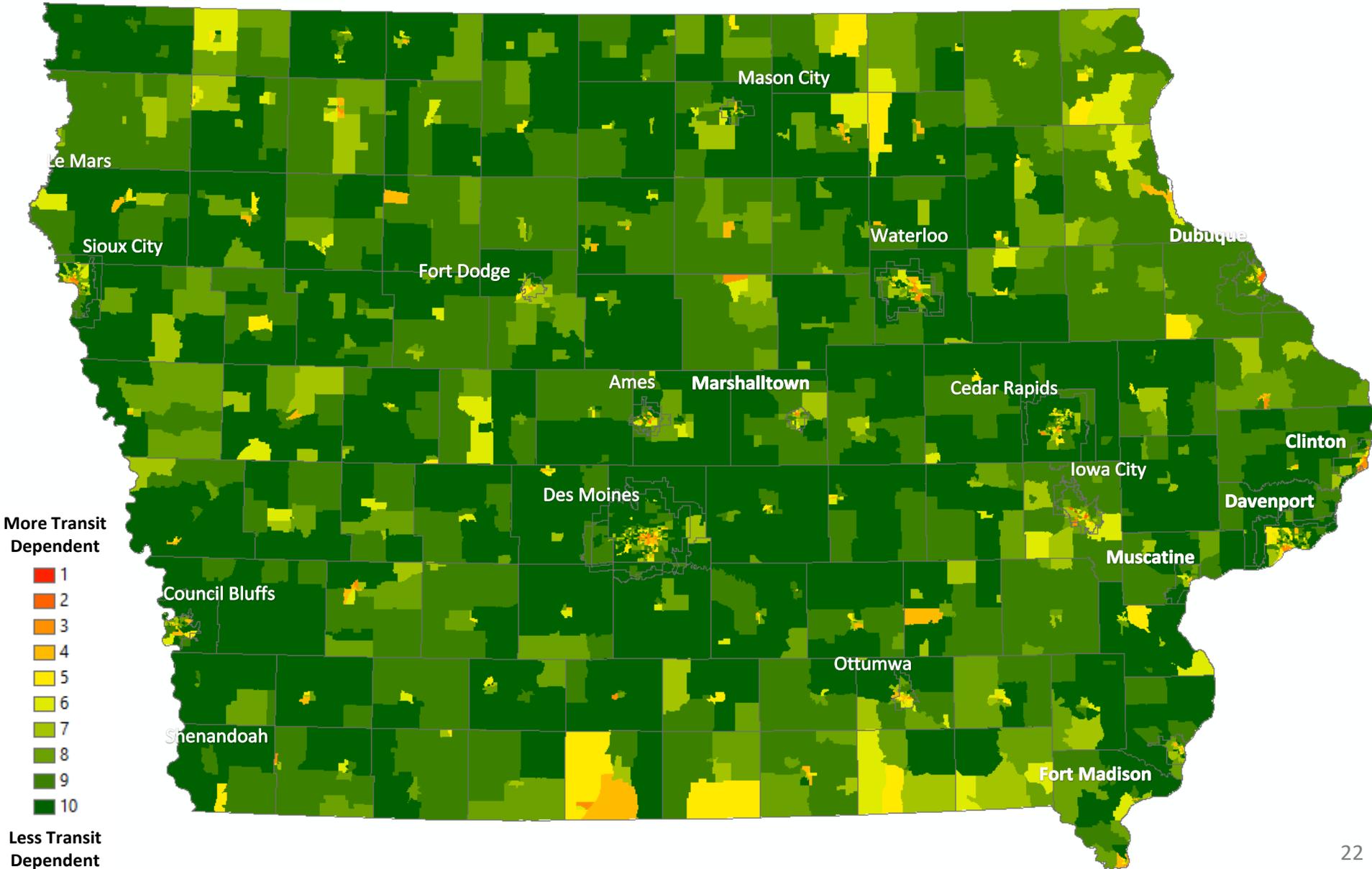
Transit Dependency Analysis

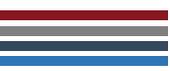




Results – Weighted Small Urban Average

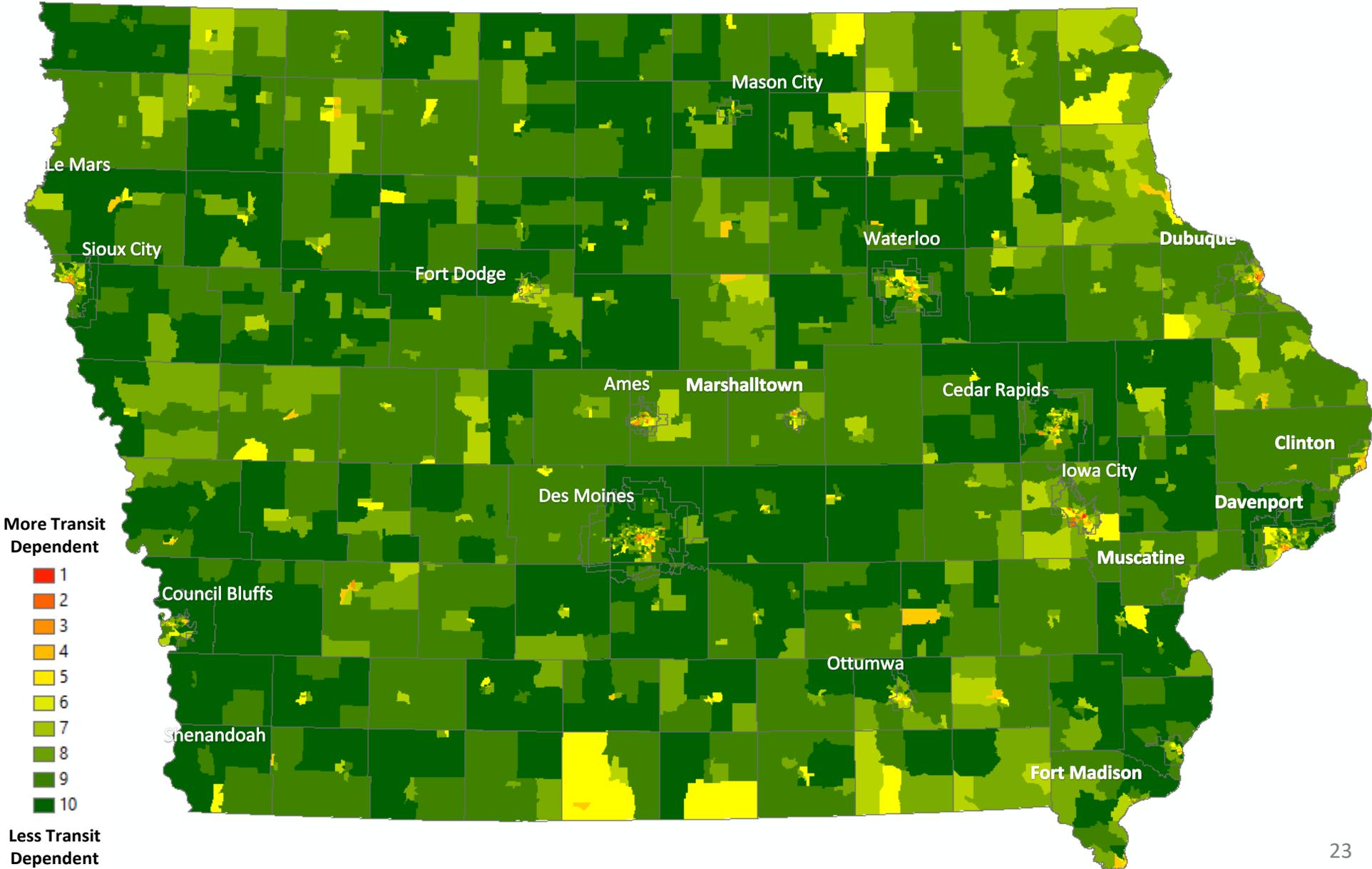
Transit Dependency Analysis

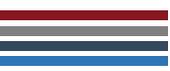




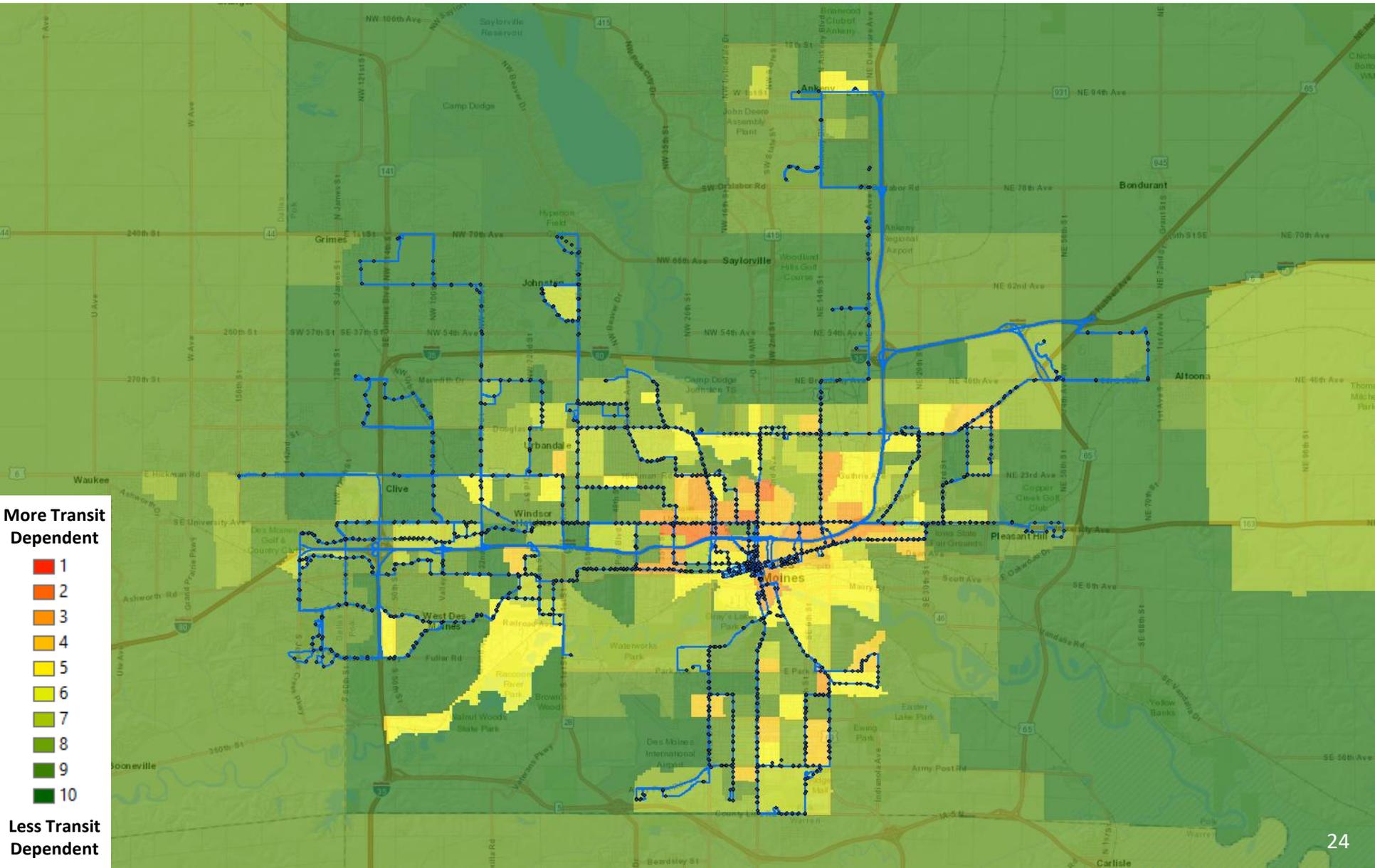
Results – Weighted Large Urban Average

Transit Dependency Analysis





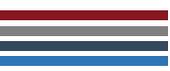
Example Application of Overall Composite Transit Dependency Analysis



More Transit Dependent

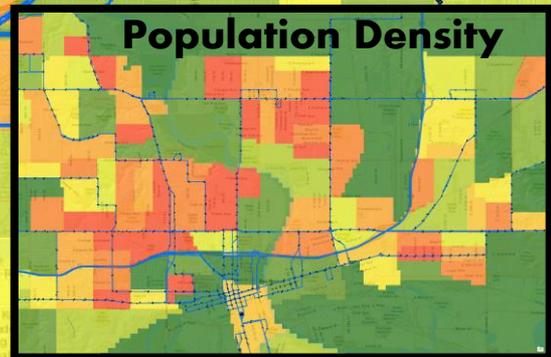
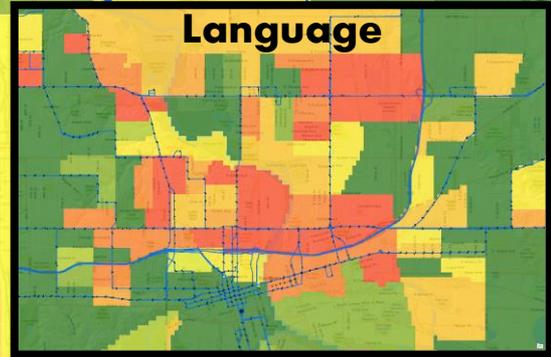
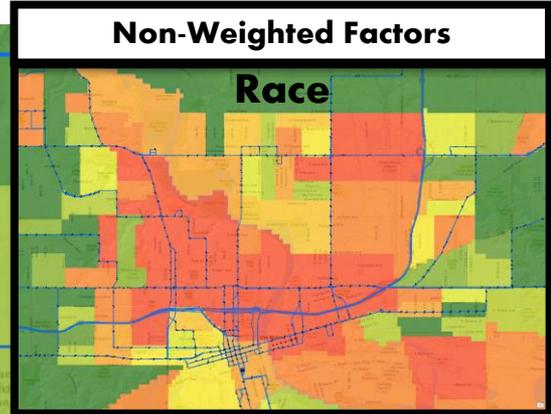
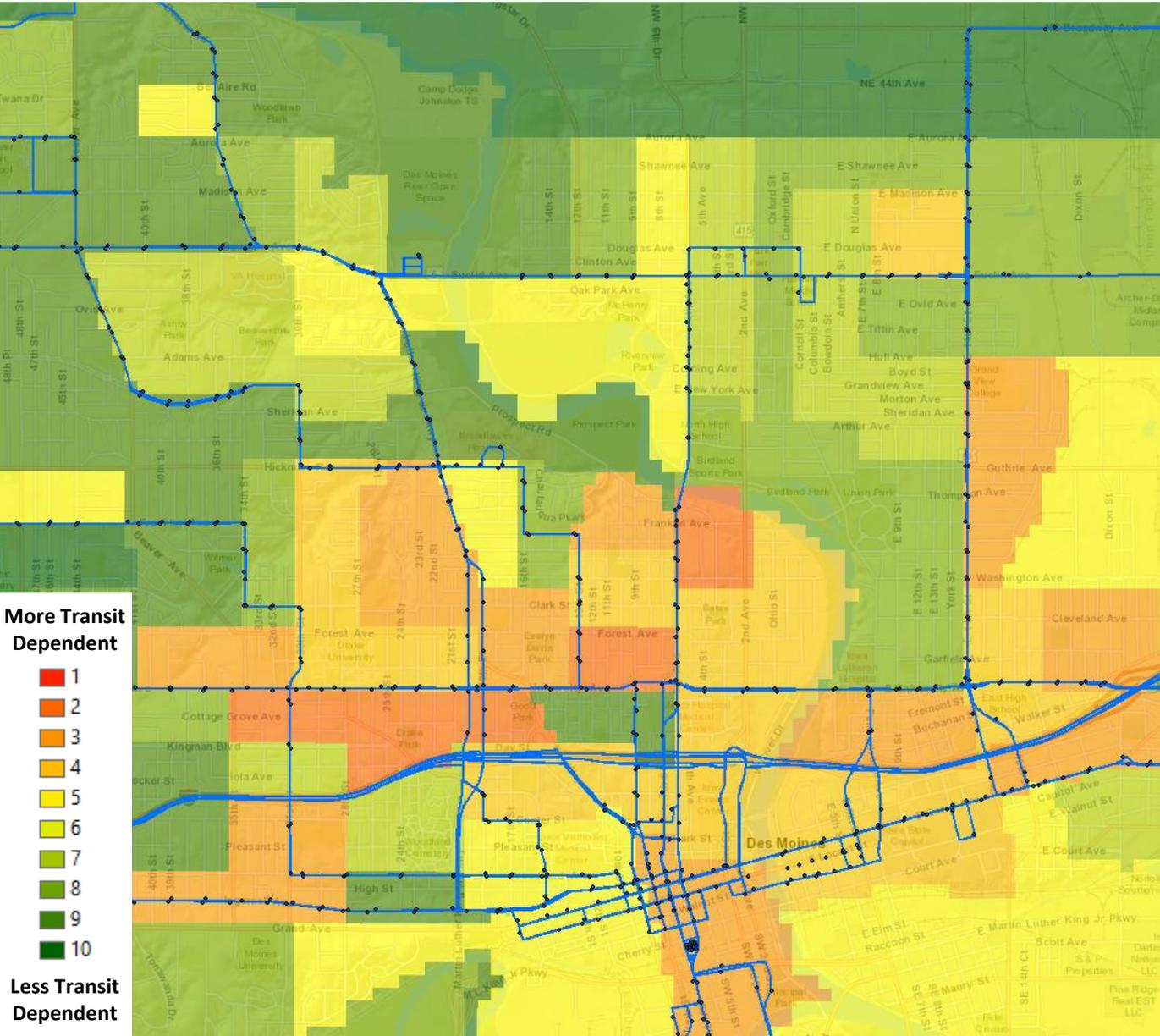
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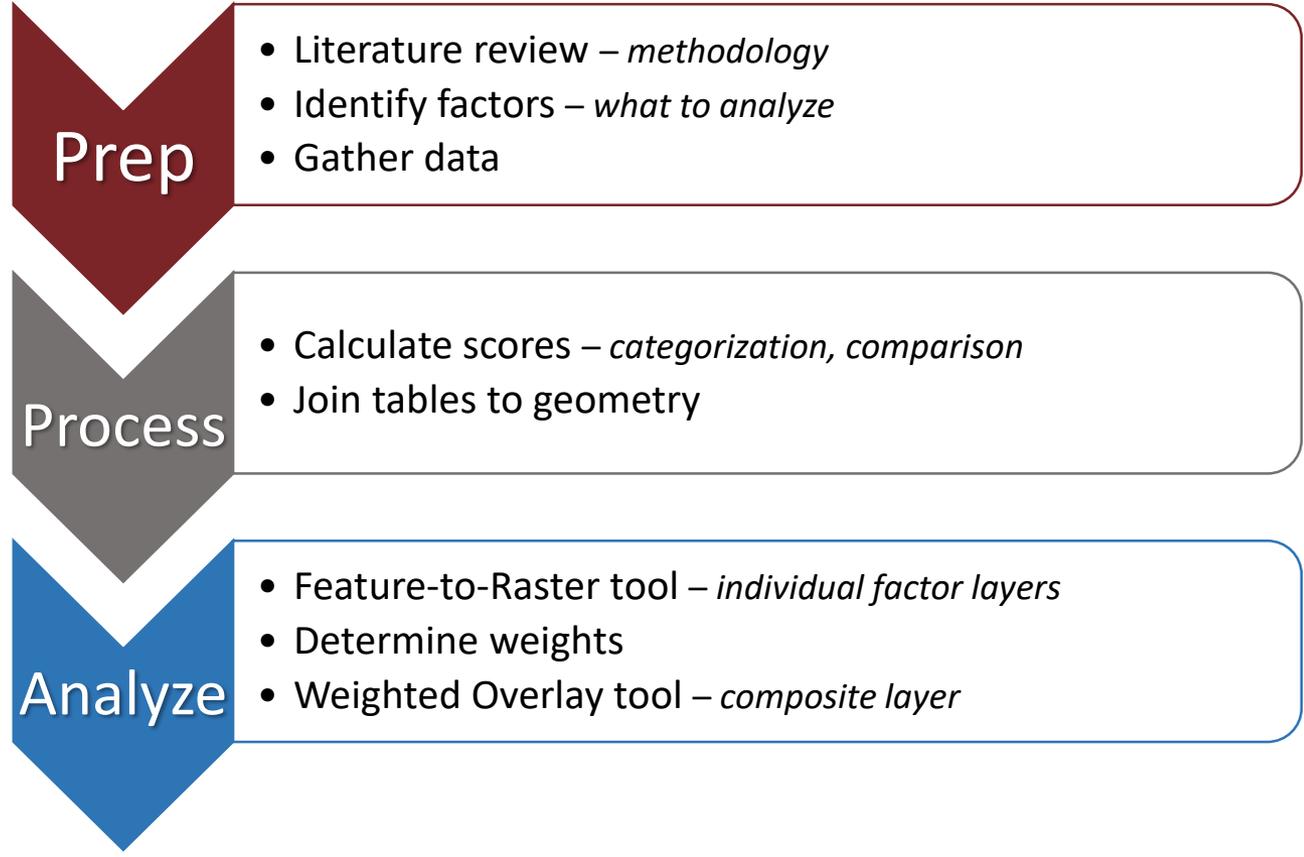
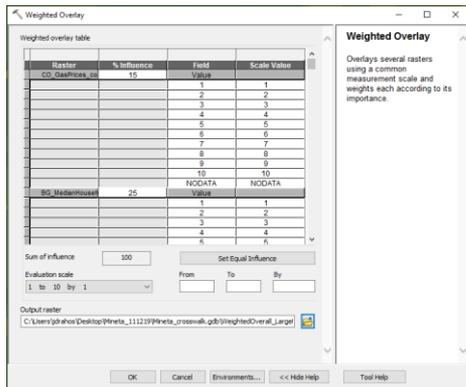
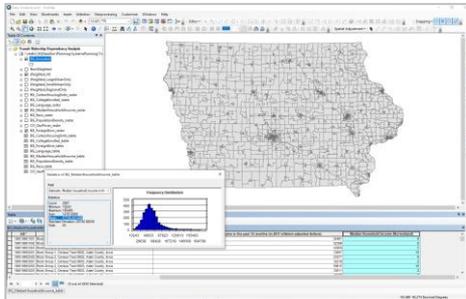
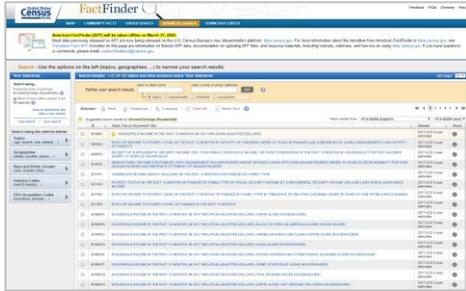
Less Transit Dependent



Example Application of Overall Composite

Transit Dependency Analysis





Sharing Results

- ▶ Individual meeting with Transit Agencies

[CANCELLED] ▶ Passenger Transportation Summit

[CANCELLED] ▶ Iowa Public Transit Association

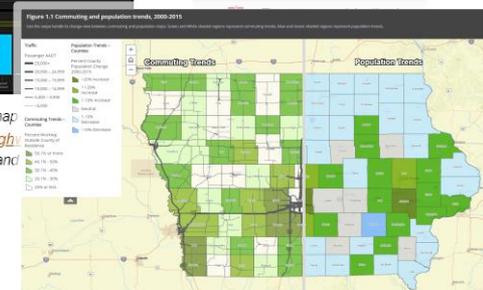
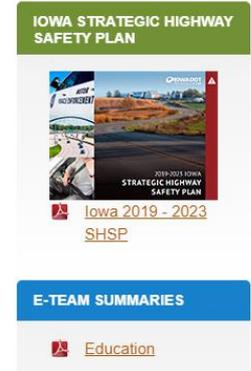
- ▶ Data available to agencies

Web Application

- ▶ Interactive web mapping application through ArcGIS Online (AGOL)
- ▶ Strategic Highway Safety Plan (SHSP) example
- ▶ ArcGIS Transit Tools example

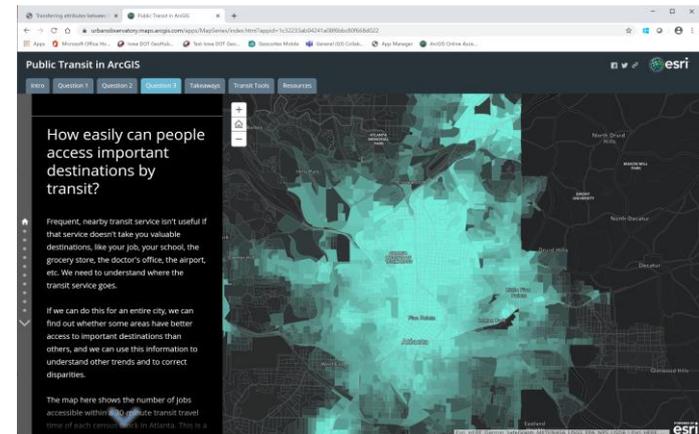
Example 1 – DOT SHSP web page

An SHSP is a statewide-coordinated safety plan that provides a comprehensive framework for reducing highway fatalities and serious injuries on all public roads. The SHSP establishes statewide goals, objectives and key emphasis areas developed in consultation with federal, state, local and private sector safety stakeholders.



Strategic Highway Safety Plan story map
Available - 2019-2023 Iowa Strategic Highway Safety Plan
Best viewed in Chrome, Firefox and Safari

Example 2 – ArcGIS Transit Tools



THANK YOU
FOR YOUR ATTENTION

What are your questions?

References

Methodology

<https://transweb.sjsu.edu/research/investigating-determining-factors-transit-travel-demand-bus-mode-us-metropolitan>

Data

<https://factfinder.census.gov/> redirect to <https://data.census.gov/cedsci/>

<https://gasprices.aaa.com/?state=IA>

<https://www.gasbuddy.com/>

<https://iowa-gtfs.com/>

Geoprocessing Tools

<https://desktop.arcgis.com/en/arcmap/latest/tools/conversion-toolbox/converting-features-to-raster-data.htm>

<https://desktop.arcgis.com/en/arcmap/latest/tools/spatial-analyst-toolbox/how-weighted-overlay-works.htm>

Visualization

<https://urbanobservatory.maps.arcgis.com/apps/MapSeries/index.html?appid=1c32233ab04241a08f6bbc80f668d022>